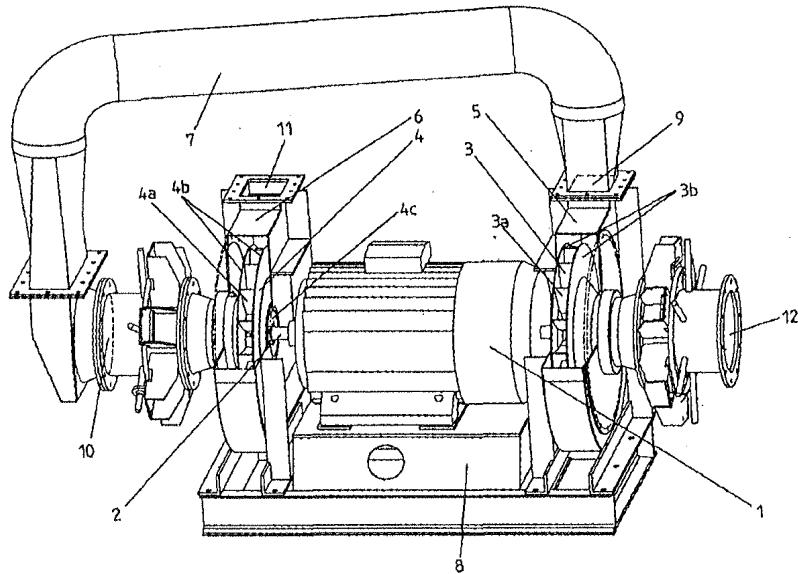




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(54) Title: HIGH-PRESSURE FAN



## (57) Abstract

The invention relates to a high-pressure fan comprising a blade wheel (3, 4), a fan housing (5, 6) surrounding the blade wheel and an electric motor (1) to operate the blade wheel. To eliminate the problems related to the mounting of the blade wheel, the blade wheel (3, 4) at least mainly consists of light carbon-fibre-based composite material and is directly mounted on the shaft (2) of the electric motor (1).

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## HIGH-PRESSURE FAN

The invention relates to a high-pressure fan comprising a blade wheel, a fan housing surrounding the blade wheel and an electric motor to 5 operate the blade wheel.

With a high-pressure fan implemented according to the prior art, having a blade wheel of steel blades with separate roller bearings, it is at best possible to achieve a pressure rise of a few dozens of kPas at one stage. When the prior art technology is applied, the high-pressure fan has to be 10 implemented as a two-staged or multi-staged series-connected arrangement if a higher rise in the pressure is to be achieved.

The determining factor in the mechanical implementation of the high-pressure fan of the prior art is the weight and strength of the steel blade wheel. Because of the heavy blade wheel compromises have to be made as 15 regards the dimensioning of bearings. The bearings must endure the great stress put on them by the weight of the blade wheel, and also sustain the centrifugal forces resulting from the high rotation speed, and heat production in the roller elements. For the fan to operate smoothly, the critical rotation speed of the rotor system has to be above the operating rotation speed. In 20 practice, this results in such dimensioning in which the roller bearings used are relatively large, and the heat generated in the bearings is led away by means of an effective oil circulation lubricating system.

Due to the above-mentioned features, both the single-staged and multi-staged versions of the existing high-pressure fans have to be provided 25 with separate bearings, either roller or slide bearings, since the bearings of the electric motor do not endure the stress caused by a steel blade wheel.

An object of the present invention is to eliminate the drawbacks described above. This is achieved with a high-pressure fan of the invention, characterized in that the blade wheel at least mainly consists of carbon-fibre- 30 based composite material, and is mounted directly on the shaft of the electric motor.

By making the blade wheel of a high-pressure fan or its essential components of carbon-fibre-based composite material the weight of the blade wheel can be reduced to a fraction of the weight of a steel blade wheel. A 35 blade wheel made of this material can be dimensioned to be as strong as the steel blade wheel or even stronger. The light composite blade wheel can be

mounted directly on the shaft of a standard electric motor without the stress on the bearings increasing too high. By means of an AC inverter a fan implemented in this way can be rotated up to the maximum rotation speed given by the manufacturer of the bearings.

5        When an electric motor is preferably implemented with a shaft going through it, and a blade wheel of composite material is mounted on the shaft of the motor at its both ends, the axial forces generated in the blade wheels will cancel each other out, and hence it will be possible to use the standard bearings of the electric motor. The sides of the fan implemented in this way  
10 can be interconnected with an intermediate channel, i.e. it is possible to provide a two-staged fan which replaces the conventional version implemented with two separate fans. The fan arrangement can naturally be used as two separate series-connected fans without the above-mentioned intermediate channel.

15        Compared with the conventional two-staged fan implemented with two separate fans, the two-ended fan of the present invention allows to dispose of 4 bearings with their casings and circulation lubricating units as well as of couplings between the electric motor and the blade wheel arrangement since no separate bearings are needed. Furthermore, the arrangement is  
20 compact, a simple and cheap steel bed can be used as its bed, and no multi-level bed arrangements are needed in the installation.

In the following, the invention will be described by means of one preferred embodiment with reference to the accompanying drawing, which illustrates a perspective of a high-pressure fan of the invention.

25        The high-pressure fan illustrated in the drawing has as its source of motive power an electric motor 1, comprising a rotor shaft 2 going through it, i.e. a shaft the ends of which project at both sides of the motor 1. A light blade wheel 3 and 4, which at least mainly consists of carbon-fibre-based composite material, i.e. at least its blades 3a, 4a and end plates 3b, 4b are of said  
30 material, is mounted directly onto the both ends of this shaft without separate bearings. The hub 4c of the blade wheel may also be of some other material, e.g. steel. This direct mounting means that only the bearings of the electric motor 1 are used for mounting the whole above-mentioned arrangement. The blade wheels 3 and 4 are surrounded by fan housings 5 and 6, and the  
35 pressure opening 9 of the first housing 5 is connected to the suction opening 9 of the second housing 10 with an intermediate channel 10.

Reference number 11 denotes the pressure opening of the second housing 6, and reference number 12 the suction opening of the first housing. The view of the housings 5 and 6 illustrated in the drawing is partially sectional. The whole fan arrangement described above is placed on a simple 5 steel bed 8.

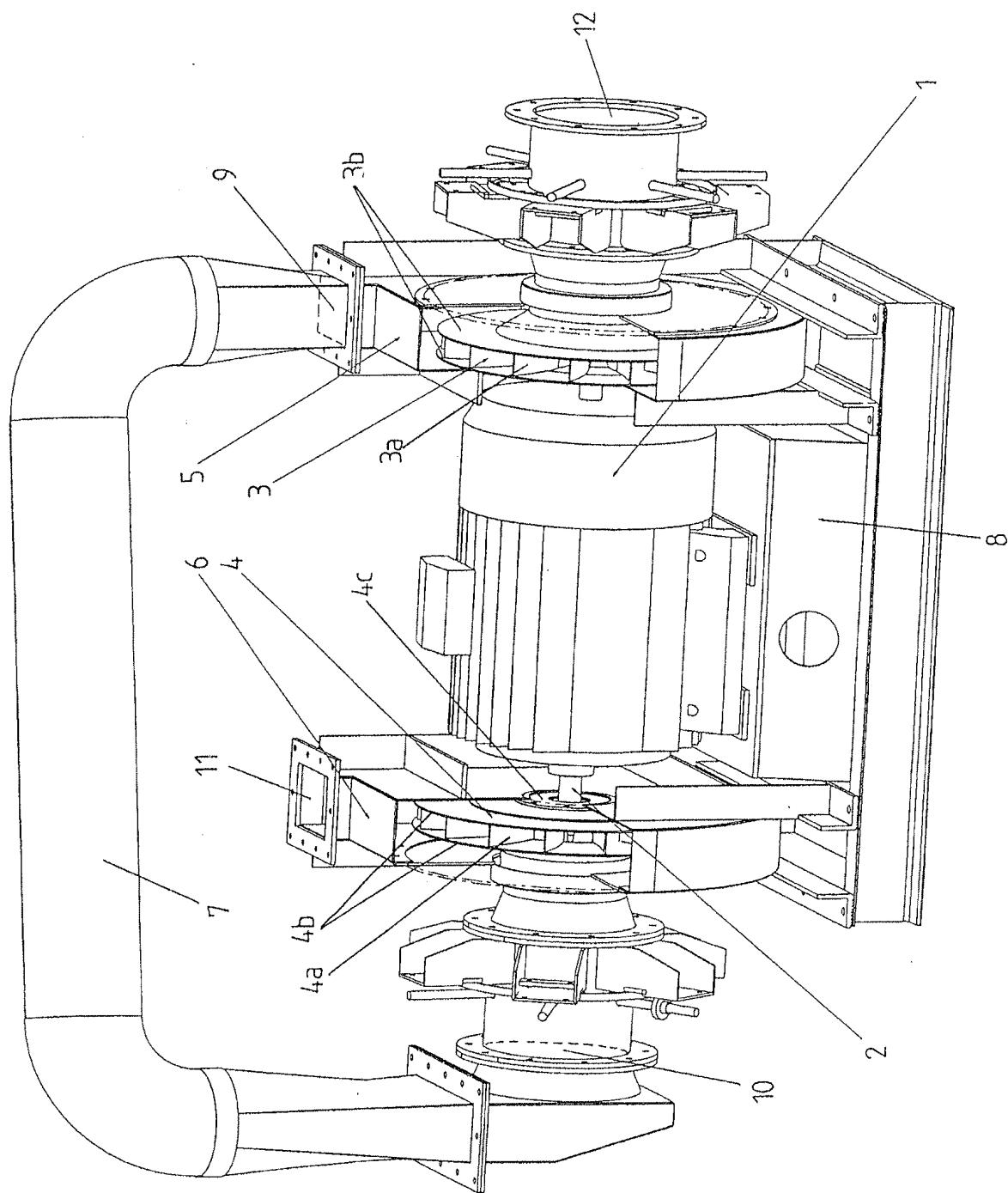
Due to the connecting intermediate channel 7 the fan illustrated in the drawing functions as a two-staged fan. If this intermediate channel 7 is removed, the fan arrangement will function as two separate series-connected fans.

10 The invention has been described above only by means of one preferred embodiment. One skilled in the art can, however, implement the fan of the invention and its details in several alternative ways within the scope of the appended claims. For example, there could be a blade wheel only at one 15 end of the motor, and the axle could be implemented in such a way that it does not go through the motor. Correspondingly, there could be several blade wheels at both ends of the motor or only at one end of it.

## CLAIMS

1. A high-pressure fan comprising a blade wheel (3, 4), a fan housing (5, 6) surrounding the blade wheel and an electric motor (1) to operate the blade wheel, **characterized** in that the blade wheel (3, 4) 5 at least mainly consists carbon-fibre-based composite material and is mounted directly on the shaft (2) of the electric motor (1).
2. A high-pressure fan as claimed in claim 1, **characterized** in that the electric motor (1) has a shaft (2) going through it, and at the both ends of the electric motor (1) there is a blade wheel (3, 4) arranged directly on 10 the shaft (2) of the motor.
3. A high-pressure fan as claimed in claim 2, **characterized** in that the fan housings (5, 6) surrounding the blade wheels (3, 4) are interconnected with an intermediate channel (7).
4. A high-pressure fan as claimed in claim 3, **characterized** 15 in that the intermediate channel (7) leads from the pressure opening (9) of one of the housings (5) to the suction opening (10) of the other housing (6).

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## INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 98/00037

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F04D 25/16

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: F04D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB 920188 C (SOCIETE ANONYME DES ETABLISSEMENTS NEU), 6 March 1963 (06.03.63), figure 1 --	2,3
Y	US 1014321 A (D.B. MINOR), 14 January 1912 (14.01.12), figure 1 --	1,2,3,4
Y	US 2903182 A (S.H. DOWNS), 8 Sept 1959 (08.09.59), figure 1 --	3,4
Y	US 4746266 A (KIRCHNER ET AL), 24 May 1988 (24.05.88), figure 1 --	1,2,3,4

 Further documents are listed in the continuation of Box C. See patent family annex.

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 5464325 A (ALBRING ET AL), 7 November 1995 (07.11.95), figure 3 -----	1,2,3,4

**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

02/03/98

International application No.	
PCT/FI 98/00037	

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
GB 920188 C	06/03/63	NONE		
US 1014321 A	14/01/12	NONE		
US 2903182 A	08/09/59	NONE		
US 4746266 A	24/05/88	DE 3631942 A,C EP 0261490 A,B		07/04/88 30/03/88
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